

Exploring the use of mobile apps for self-management of mental health treatment: *scoping review*

Explorando o uso de aplicativos móveis para autogestão do tratamento em saúde mental: *scoping review*

Explorando el uso de aplicaciones móviles para la autogestión del tratamiento de salud mental: *revisión de escopo*

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Abstract: Objective: to map the scientific literature produced on mobile applications for self-management of mental health treatment. **Method:** scoping review conducted in five databases in Portuguese, English or Spanish in November 2020 with the descriptors mental health, mental illness, mental disorder, psychiatric illness, mobile applications, app, *self care, self management, and self monitoring*. **Results:** 46 articles were found, mostly related to development, effectiveness, user perception or search for apps in specialized stores and focused on self-monitoring of mood (13%) or management of mental illness in general (23.9%). **Conclusion:** the studies evidenced variety and effectiveness of mobile apps for different mental disorders. The construction of new apps for self-management in MS should be supported by evidence, with public participation and with representative samples that, in fact, portray the expectations and motivations of the user for the use of these technologies in self-management of their treatment.

Descriptors: Mental health; Mobile applications; Self-management; Smartphone; Review

Resumo: Objetivo: mapear a literatura científica produzida sobre aplicativos móveis para a autogestão do tratamento em saúde mental. **Método:** revisão de escopo realizada em cinco bases em português, inglês ou espanhol em novembro de 2020 com os descritores *mental health, mental illness, mental disorder, psychiatric illness, mobile applications, app, self care, self management e self monitoring*. **Resultados:** encontraram-se 46 artigos relacionados, em sua maioria, com desenvolvimento,

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eficácia, percepção dos usuários ou busca de aplicativos em lojas especializadas e com foco no automonitoramento do humor (13%) ou gestão de doenças mentais, em geral (23,9%). **Conclusão:** os estudos evidenciaram variedade e eficácia de aplicativos móveis para diferentes transtornos mentais. A construção de novos aplicativos para autogestão em SM deve ser sustentada em evidências, com participação do público e com amostras representativas que, de fato, retratem as expectativas e motivações do usuário para o uso dessas tecnologias na autogestão de seu tratamento.

Descritores: Saúde mental; Aplicativos móveis; Autogestão; Smartphone; Revisão

Resumen: Objetivo: mapear la literatura científica sobre aplicaciones móviles para la autogestión del tratamiento de salud mental. Método: revisión de escopo realizada en cinco bases de datos en portugués, inglés o español en noviembre de 2020 con los descriptores *mental health, mental illness, mental disorder, psychiatric illness, mobile applications, app, self care, self management e self monitoring* Resultados: Se encontraron 46 artículos, en su mayoría relacionados con el desarrollo, la eficacia, la percepción de los usuarios o la búsqueda de aplicaciones en tiendas especializadas y centrados en el autocontrol del estado de ánimo (13%) o la gestión de la enfermedad mental en general (23,9%). Conclusión: los estudios evidenciaron la variedad y eficacia de las aplicaciones móviles para diferentes trastornos mentales. La construcción de nuevas aplicaciones para la autogestión en las PYMES debe sustentarse en pruebas, con la participación del público y con muestras representativas que, de hecho, retraten las expectativas y motivaciones del usuario para el uso de estas tecnologías en la autogestión de su tratamiento.

Descritores: Salud mental; Aplicaciones móviles; Automanejo; Teléfono inteligente; Revisión

Introduction

With the evolution of smartphones, Mobile Applications (Apps) can become tools for tracking information, as well as serving as an incentive for self-care for people and a resource to be employed by health professionals.¹ mHealth mobile technologies are an effective means of providing psychological and psychiatric treatment, if their offer is based on scientific evidence and contributes to helping users become increasingly informed and active in the face of their treatment.²

With new investments and changes in the mental health (MH) care model worldwide, the patient becomes increasingly co-responsible for monitoring and caring for their health. However, most Apps aimed at self-management focus on chronic physical conditions for people in MH treatment, still little explored, although they offer potential to provide education, promote self-management, and support rehabilitation goals.³

User interaction with self-management Apps can affect family members and/or caregivers with a cascading effect, arousing their curiosity and encouraging shared monitoring of symptoms, medication schedules, awareness of the implementation of positive lifestyle changes, clinical

progression, and relapses.⁴

The concept of Health Self-Management, originally called "self-management", was first used by Thomas Creer in the mid-1960s. It represents a set of actions to encourage the active participation of patients in their treatment, with the purpose of minimizing the impact of the disease and improving physical, mental, and social health functioning.⁵

Self-management of treatment in MH through Apps and online tools helps the user to build connection with their own health, have more adherence and reduce the time spent on psychiatric and psychological treatment. It also optimizes outcomes, risk reduction, and more understanding of the determinants that promote health, as well as boosting skills for changing habits, attitudes, and lifestyle changes.⁶

Based on these considerations, this literature review is justified to know the existing scientific production in the area and to support the development of future mobile technologies for self-management of treatment in MH, with the following objective: to map the scientific literature produced on mobile applications for self-management of treatment in MH.

Method

This is a scoping review study according to the JBI recommendations, following the steps 1) identification of the research question and objective; 2) identification of relevant studies that would enable the breadth and scope of the review purposes; 3) study selection, according to predefined criteria; 4) data mapping; 5) summarization of results by qualitative thematic analysis; 6) presentation of results with identification of implications for policy, practice or research.⁷

The formulation of the research question followed the PCC strategy, mnemonic of population (P), concept (C) and context (C): What has been developed in scientific research on the use of Apps for self-management in the context of treatment in MH? Established as inclusion criteria in this review were primary studies that addressed the use of Apps for self-management of treatment in MH, regarding the construction, evaluation, usability, opinion and perception of users and health

professionals, among other aspects, published in Portuguese, English or Spanish. Exclusion criteria were articles without abstracts, without the possibility of identifying the relationship with the theme (title and abstracts) and study protocols. To cover the largest quantity of publications, no time frame was established for the inclusion of articles.

The search strategies were conducted in three steps. Initially, "Mobile Applications", "Mental Health" and "Self-management" were used in the Medical Literature Analysis AND Retrieval System Online via the US National Library of Medicine (MEDLINE/PubMed) to find uncontrolled descriptors contained in the articles of interest. Then, combinations of controlled descriptors, obtained from Medical Subject Headings (MeSH) and non-controlled descriptors, obtained from the initial search, and augmented by the Boolean operators "OR" and "AND", were performed. Finally, this strategy was adapted for each database.

Chart 1- Search strategies used per database. São Paulo, SP, Brazil, 2020.

Database	Strategy
PubMed®	((("Mental Health"[Mesh] OR "Mental Health"[tiab])) AND "mobile applications" AND ("Self-Care"[Mesh] OR "Self-Care"[tiab] OR "self-management"))
Embase®	('self-management'/exp OR 'self-management' OR 'self-care'/exp OR 'self-care' OR 'self-regulation'/exp OR 'self-regulation' OR 'self-monitoring'/exp OR 'self-monitoring') AND ('mobile applications' OR apps OR 'mobile apps' OR smartphone OR ehealth OR 'mobile health') AND 'mental disease'/mj
CINAHL®	((MH "Self-Management") OR (MH "Self-Care")) OR TI ("self-management" or "self-care" or "self-regulation" or "self-monitoring") OR AB ("self-management" or "self-care" or "self-regulation" or "self-monitoring") AND (MH "Mental Health") OR TI ("mental health" or "mental illness" or "mental disorder" or "psychiatric illness") OR AB ("mental health" or "mental illness" or "mental disorder" or "psychiatric illness") AND (MH "Mobile Applications") OR TI ("mobile applications" or apps or "mobile apps" or smartphone or ehealth or "mobile health") AND AB ("mobile applications" or apps or "mobile apps" or smartphone or ehealth or "mobile health")
Web of Science®	((("Mobile Applications" OR App) AND ("Self-Management" OR "self-monitoring" OR "self-management" OR "self-insight") AND (Psychiatry OR "Mental Health" OR "Mental illness" OR "mental disorder"))
Portal Regional da BVS®	("Aplicativos Móveis" OR "Mobile Applications" OR "Aplicaciones Móviles") AND (Autogestão OR "Self-Management" OR Automanejo) AND (Psiquiatria OR Psychiatry OR Psiquiatria).

The search period for the studies was from November 1 to November 30, 2020. All articles were selected according to title and abstract, incorporated into Endnote Web software to remove

duplicates. In cases where the titles and abstracts were not sufficient to define the initial selection, the articles were selected for reading in full. After identifying the research question and objective, we followed: the critical evaluation of the primary studies included in the review with the application of the search key in the databases; the application of filters (English, Portuguese, or Spanish language).

This process was conducted by two reviewers who, based on the eligibility criteria defined by the research question, evaluated the selected studies. When there was disagreement about the inclusion/exclusion of the studies, two reviewers separately re-read the studies to resolve any remaining conflicts of disagreement, and a third reviewer reevaluated and broke the tie. Study selection followed the recommendations of the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)⁸, Figure 1.

We proceeded to map the studies, according to the following variables: identification, authors, year of publication, country, journal, App focus, objectives, and results (Chart 2). The data were compared with rigorous analysis, in search of identifying specificities before the research theme, which required interpretative effort to group them according to the similarity of the theme. The studies were synthesized using a descriptive analytical structure and presented in categories, followed by reflections during the analysis and conclusion of the study.⁷

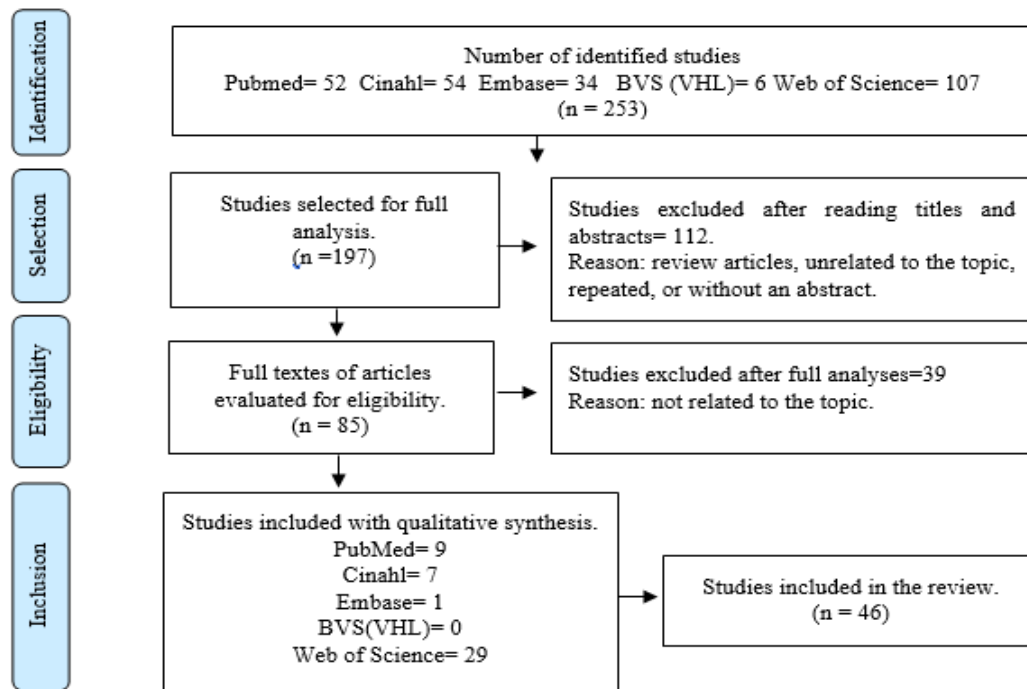


Figure 1- Flowchart of article selection based on the steps: identification, screening, eligibility and inclusion, São Paulo, SP, Brazil, 2020.

Results

A total of 253 studies were identified and based on the inclusion/exclusion criteria, a total of 46 primary studies were obtained for analysis, published between 2015 and 2020.

Chart 2- Characterization of the studies included in the review (n=46). São Paulo, SP, Brazil. 2020.

Year/Country/ Periodical/ Reference	App Focus	Objectives of the study	Results
2015/Finland/Nordic Contr. Informations ⁹	Stress management.	Explore the need for stress management solutions in an academic organization.	The study showed that most participants found the App useful and would recommend it to others.
2015/USA/JMI R <i>Mental Health</i> ¹⁰	Self-Management of Post-Traumatic Stress Disorder (PTSD).	Characterize reach, use, and impact of the <i>posttraumatic stress disorder (PTSD) Coach</i> App.	PTSD-Coach had substantial and sustained reach in the population was favorably received.
2015/Ireland/JMI R <i>Mental Health</i> ¹¹	Self-monitoring of moods.	Evaluate the feasibility of the <i>Cope Smart</i> App.	Results suggest that MH Apps is a viable means to promote positive MH.
2015/Germany/BMC <i>Psychiatry</i> ¹²	Bipolar Disorder (TB) treatment self-monitoring.	Examine the validity of the App <i>Life-Chart Method</i> of the National Institute of Mental Health Personal (Life Chart	Study provides evidence of the validity of the Life-Chart method as a valid tool for recognizing manic and depressive episodes.

		(PLC App).	
2015/Spain/ BMC <i>Psychiatry</i> ⁴³	Monitor symptoms/signs and enhance the BD self-management	Develop and validate smartphone App to monitor symptoms/signs and empower self-management.	The App can improve the outcome of BD sufferers in a practical and safe way.
2015/Australia <i>JMIR</i> ⁴⁴	BD Apps.	Identify the types of App available in the Google Play and iOS stores. Evaluate features and quality of content.	Content not in compliance with practice guidelines or self-management principles. They do not provide information to help users evaluate their quality.
2017/Australia/ <i>BMJ Journal</i> ⁴⁵	Suicide prevention.	To evaluate the effectiveness of the iBobbly self-help app for suicide in Indigenous people.	Reduces distress and depression, but shows no significant reductions in suicidal ideation
2016/USA/ <i>Journal of Medical Internet Research</i> ⁴⁶	Online body image intervention.	Explore corresponding engagement/usability issues of the Healthy Body Image Program.	The participants were satisfied with the overall usability of the program.
2016/Australia/ <i>JMIR Mhealth Uhealth</i> ⁴⁷	Self-monitoring of mood.	Describe the development of a mobile phone tool to monitor emotional changes	He confirmed through survey and focus group methods that the App was functional and usable.
2016/USA/ <i>General Hospital Psychiatry</i> ⁴⁸	Self-management of PTSD in Primary Health Care (PHC).	Evaluate the feasibility and effectiveness of using the <i>PTSD Coach</i> App in primary care	App improved symptoms, sense of recovery, and personal functioning. 89% of testers found it helpful for self-management.
2017/Japan/ <i>Journal of Medical Internet Research</i> ⁴⁹	Cognitive Behavioral Therapy (CBT) for pharmacotherapy-resistant major depression	Evaluate efficacy of Cognitive Behavioral Therapy (CBT) as adjunctive therapy among patients with antidepressant-resistant major depression.	It is worth considering clinically the adjunctive use of the CBT App when treating patients with antidepressant-resistant depression using the smartphone.
2017/USA/ <i>Translational Behavioral Medicine</i> ²⁰	Self-management of PTSD in PHC.	Develop and test CS PTSD <i>Coach</i> App	App is compatible with current practice. Designed to meet the needs of the patient.
2017/ Lebanon / <i>Psychiatry Services</i> ²¹	Medical and psychiatric interventions for people with mental illness.	Describe the development of the App <i>Peer and Supported Self-Management Technology (Peer TECH)</i> .	A potentially effective approach in improving the access, reach and sustainability of integrated self-management interventions.
2018/Australia/ <i>Journal of Effective Disorders</i> ²²	Humor self-monitoring app.	Examine efficacy for self-monitoring cell phones, investigating relationships between the App and MH outcomes.	Improvements in the users' MH, well-being, and self-awareness.
2018/ Denmark <i>JMIR Mental</i>	Promoting daily life management in	Explore how the smartphone App (Mind-Frame) was used to	It promoted power in the daily management of life. It could feed the fear

<i>Health</i> ²³	young adults with schizophrenia.	promote daily management of living with the disease.	of containment and exacerbation of the disease, preventing some from feeling uncertain and secure.
2018/ Denmark /JMIR <i>Mhealth Uhealth</i> ²⁴	Self-monitoring tool for individuals in recovery from an Eating Trans (ED).	Explore patients' experiences with the Recovery Record as part of outpatient treatment for ED.	The App and its features were found to be conducive to daily life and treatment of ED, while others found it mainly obstructive.
2018/ Germany/ <i>Psychiatry Research</i> . ²⁵	Be Good to Yourself smartphone self-help app for depressive symptoms.	Assess feasibility and effectiveness of the App in participants who reported subjective need for help.	The primary endpoint was a reduction in depressive symptoms. Secondary outcomes included improved self-esteem and quality of life.
2018/Spain/ JMIR <i>Mhealth Uhealth</i> ²⁶	Stress management and control.	Present a review of the App found for stress management.	The analysis shows that Apps are adding new functionality and becoming feature-rich integrated self-management systems.
2018/Australia/J MIR <i>Mental Health</i> ²⁷	Self-monitoring of humor.	Address the gap between guidelines on monitoring and the real-world practice of signing an App with young people.	To achieve positive outcomes for youth using technology-based interventions, it is critical to understand and incorporate the expectations and motivations of youth and clinicians.
2018/USA/ <i>Military Medicine</i> ²⁸	Stress reduction, sleep promotion, and alcohol moderation.	Conduct usability and health assessment studies to establish the quality of the App <i>Personal Health Intervention Toolkit</i> (PHIT) for Duty.	The evaluations showed positive results and affirmed the use of the App as a good alternative in mobile health research.
2018/Australia/ JMIR ²⁹	Users' Perceptions of Depression Monitoring Apps.	Explore the natural patterns of App use among depressive patients.	Factors that influenced usage include accessibility, perceptions of technology, and personal compatibility.
2018/ Australia/ JMIR ³⁰	Self-monitoring of depression.	Perform a usability evaluation of a personalized, self-guided, App-based intervention for depression.	Encourage participant engagement through self-monitoring and feedback in order to maintain participation in self-guided interventions.
2018/USA <i>Journal of Technology in Human Services</i> ³¹	Management of auditory hallucinations, social functioning, medication use, humor, and sleep problems.	Describe the use of specific Apps subcomponents and determine whether demographic and clinical characteristics were associated with higher or lower overall Virtual Hope Box (VHB) use.	Use may be associated with changes in health outcomes. Future studies should recruit larger and more diverse samples to further explore the relationships between use and demographic predictors.
2018/USA/ <i>Psychiatric Services</i> ³²	Management of auditory hallucinations, medication use, humor, and sleep problems.	Evaluate the performance of mHealth compared to more traditional treatment.	The groups showed improvements in recovery, seen in the post-treatment WRAP group, and in recovery and quality of life in the FOCUS group at six months.
2019/USA/	Control of stress,	Validate the effectiveness of	Effective in reducing symptoms in

<i>Journal of Medical Internet Research</i> ³³	anxiety, and depression.	the <i>Pacifica</i> App.	individuals who use thought logs and are not taking medication.
2019/Germany/ <i>Frontiers in Psychiatry</i> ³⁴	Self-monitoring of humor.	Feasibility of mixed methods to develop a self-help App for young people with MH problems	Emojis can be used to identify positive and negative feelings, and individual patterns can be helpful. However, these should be done with professional advice.
2019/Canada/ <i>PLoS one</i> ³⁵	Redução de sintomas e suporte na esquizofrenia.	Viabilidade de um App móvel focado na esquizofrenia.	É viável nos indicadores de resultado e processo; é uma tecnologia pronta para avançar em ensaios clínicos e testes de validação.
2019/USA/ <i>JMIR Mhealth Uhealth</i> ³⁶	Reduction of psychoactive substance use (SP).	Evaluate aesthetics/quality of information from free or low-cost Apps to reduce SP usage.	Few commercially available Apps have yielded in research evidence-based integrated interventions.
2019/Portugal/ <i>Archives of Clinical Psychiatry</i> ³⁷	Reduction of symptoms in the person with schizophrenia.	Describe the development of the App <i>WeCope</i> , for people with schizophrenia	The App improved symptoms, sense of recovery, and personal and social functioning.
2019/USA/ <i>JMIR Mental Health</i> ³⁸	Symptom management in EDs.	Evaluate the self-help effectiveness of the Recovery Record.	The group with the App achieved 6.2% more clinical improvement and had a higher remission rate.
2019/Reino Unido/ <i>JMIR</i> ³⁹	Self-monitoring for early signs of psychosis	Figure out implementation expectations before testing and synthesize that data into a framework.	Users focused their reports on subjective experiences. Staff reported more facts about the impact on staff interactions with service users.
2019/Israel/ <i>JMIR</i> ⁴⁰	Search for SM Apps in the App stores	Present objective, real-world data on user engagement with popular MH Apps	While the number of app installations and daily active minutes of use may seem high, only a small portion of users made use of these for an extended period of time.
2019/USA/ <i>Professional Psychology</i> ⁴¹	Apps for self-monitoring of MH.	Examine the prevalence of Apps use among war veterans.	In general, they are using in different age cohorts for various MH and behavioral problems with favorable perceptions of them.
2019/United Kingdom/ <i>JMIR</i> ⁴²	Self-monitoring for early signs of psychosis.	Design set of self-report items assess symptoms and acceptance of the <i>EX-PRESS</i> App.	Apps are acceptable for long-term symptom monitoring by individuals with schizophrenia across a wide age range.
2019/Australia/ <i>NPJ Digital Medicine</i> ⁴³	Evaluating Apps in the App Stores.	Examine the claims invoked by means of descriptions in store.	Scientific language was the most frequently invoked form of support for the use of MH Apps.
2019/USA/	Management of	Examined whether mobile	During treatment, responders reduced

<i>Psychiatric Services</i> ⁴⁴	auditory hallucinations, social functioning, medication use, mood problems, and sleep disturbances.	health (mHealth) affects the use of in-person services among people with serious mental illness.	service use more than non-responders. After the intervention, service use by responders continued to drop (11%), while service use by non-responders increased by 8%.
2019/USA/ <i>Psychiatric Rehabilitation Journal</i> ⁴⁵	Management of auditory hallucinations, social functioning, medication use, mood problems, and sleep disturbances.	Examined how individuals with serious mental illness use an mHealth intervention to self-manage their illnesses. Explored participants' perceptions of the impact of the subjective experience of illness.	Three themes emerged in relation to participants continued daily use of FOCUS: "back-up" support, symptom management, and self-awareness. Three other themes emerged related to the impact of the intervention on participants' recovery processes: symptom acceptance, motivation, and positive outlook support.
2020/Japan/ <i>PloS ONE</i> ⁴⁶	Advise users how to improve physical/mental conditions with results from the daily record.	Effectiveness of an App for self-monitoring and self-diagnosis for college youth with mental disorders.	The App improved the General Health Questionnaire score but did not improve the Center for Epidemiologic Studies Depression Scale (CES-D) or Link Stigma Scale (LSS) scores.
2020/United Kingdom/ <i>JMIR</i> ⁴⁷	ClinTouch-based platform to help people with severe mental illness manage symptoms and relapse.	Verify the acceptability, effectiveness, and feasibility of the ClinTouch integrated platform with Streaming of information to health professionals.	Personalized early relapse alerts were included in the workflows of both national health system trusts, and 100% of health care professionals used the system in a new digital workflow.
2020/USA/ <i>Community Mental Health Journal</i> ⁴⁸	Based on acceptance and commitment therapy	Determine the acceptability of the intervention in treating PTSD symptoms in college students and refine the App.	Results showed that the intervention was highly acceptable and despite the decrease in participant adherence there was consistent improvement in resilience and rumination of thoughts.
2020/Australia/ <i>Internet Interventions</i> ⁴⁹	Unnamed app based on momentary ecological intervention.	Explore smartphone-supported voice-listener experiences and the impact of communication.	It helped him capture his experience more accurately and communicate it more effectively to the therapist.
2020/Holland/ <i>European Journal of Psychotraumatology</i> ⁵⁰	Self-help in reducing PTSD, trauma-related cognitions, lack of social support, and increasing psychological resilience	Randomized clinical trial of efficacy, usability, and user satisfaction.	There was no significant difference between the groups in change in PTSD and social support after using the App for one month. The intervention condition showed a greater decline in negative trauma-related cognitions at T2 and T3 and a greater increase in psychological resilience at T3 than the control condition.
2020/ Morocco / <i>International Journal of</i>	Analysis of Apps for anxiety.	Provide analysis of the features and functionality to the highly rated treatment and	51% of Apps used various features to motivate users to continue using, 32% provided social features including chat and

<i>Medical Informati-cs</i> ⁵¹		management for anxiety that are available for Android and iOS systems.	links to sources of help; 46% offered offline availability; 19% reported involvement of health professionals in their project.
2020/Spain/ <i>International Journal of Eating Disorders</i> ⁵²	App for people with ED based on general CBT principles.	Evaluated the clinical effectiveness of a combined mHealth intervention for ED based on CBT.	Results suggested that the frequency with which patients attended the referral MS facility after the intervention was lower for those in the experimental group than the control group.
2020/United Kingdom/ <i>Sociology of Health & illness</i> ⁵³	Apps for anxiety or depression used in self-management by individuals in England.	Investigate motivations experiences and relationships of people who use Apps for depression or anxiety.	People engage with Apps in a direct and uncomplicated way, leading to immediate symptomatic relief, but limiting the long-term benefit.
2020/Australia/ <i>JMIR mHealth and uHealth</i> . ⁵⁴	App provides cab drivers with psychoeducation, self-help, and symptom assessment and links.	Evaluate the feasibility, acceptability, and effectiveness of Driving to Health, a mobile SM website App designed for cab drivers.	(40/42, 95%) said that Driving to Health increased their awareness of their own MS; 86% (36/42) increased their knowledge of MS and 76% (32/42), their self-help behaviors.

It is noted that there is a variety in the focus of the Apps, however, 73.9% had as objective the development of an App or its effectiveness for self-management in MH. Considering that the publications found were produced from 2015 onwards, it is observed that research around self-management in MH constitutes a new and expanding field. The year of highest concentration was 2019.³³⁻⁴⁵ It is believed that this number will grow because of the need for research related to Apps and the popularization of mobile technologies.

When analyzing the publications by country, it can be seen that: 30.4% are from the United States of America (14); 23.9% from Australia (11); 8.6% from the United Kingdom (4); 6.5% from Spain (3), 13% from Japan, Denmark, and Germany (2 each); 17.3% from the Netherlands, Canada, Portugal, Ireland, Austria, Israel, Switzerland, and Morocco (1 each). It is noteworthy that no studies were found in Brazil or in any other Latin American country around self-management in MH.

Discussion

Of the 46 articles included, there is a variety about Apps on various types of conditions in SM. Some specific to some clinical condition, for example eating disorders,^{16,24,38,52} and others more comprehensive such as general mood self-monitoring,^{11,17,22,27,34} and aimed at some specific population such as Indigenous youth¹⁵ or war veterans.^{10,18,20,41}

73.9% had as their objective the development of an App or its effectiveness, indicating that this is a growing area with a view to meeting the demand for new treatment approaches. The efficacy studies included in this review point out that user expectations and opinions are important parts of a mobile App's success. However, only 13% of the reviewed publications focus on user perception, reinforcing that the area of Apps for MetS needs improvement.

In 13% of the studies, the centrality is on finding and analyzing existing Apps for a given SM question and show the existence of a huge amount of existing mobile Apps. In contrast, most focus on the development and effectiveness of new Apps (73.9%). However, the analyses conducted in the face of these findings highlight that most Apps found in online stores are irrelevant or score low on the Mobile Application Rating Scale (MARS), which assesses the quality of mobile health apps,⁵⁵ which are mostly devoid of efficacy analysis and evidence-based interventions.

Apps aimed at self-management of MH in general are the most addressed topics in the research found, constituting 11 articles.^{21,31-32,40-41,43-47,54} About the Apps for MS, the Apps VHB,³¹ FOCUS,^{32,44,45} ClinTouch⁴⁷ and PeerTECH²¹ were found, aimed at individuals with severe mental illness and comorbid medical conditions, as well as Mental App for young college students⁴⁶ and Driving to Health for taxi drivers.⁵⁴ All of these Apps have shown potential for promoting MH, wellness, and decreasing symptoms, however, further research is needed to discover new tools and functions that would increase their effectiveness.

This finding is probably since they encompass the interest of the general population, thus having a greater number of potential users. Apps for Anxiety Disorders^{33,51,53} and substance use

disorders,^{28,36} among the three main psychiatric conditions present in the Burden of Disease Study,⁵⁶ were found in low quantity in the searches, indicating a gap to be filled with the construct for these conditions. Apps for PTSD^{10,18,20,48,50} were present, however, three of the five articles were directed to the same mobile App with a focus on US war veterans.

There is a considerable number of Apps directed to MH when searching the stores,^{14,26,40,43,51} however, few of these are, in fact, based on scientific evidence or in effectiveness verification research, justifying more scientific production in this area. Although the scientific production on the effectiveness of mobile apps for self-management in MH shows that they help people to control their symptoms, promote well-being and break barriers, there is a lack of studies on the improvement of new functions.¹⁴ These articles also pointed out problems regarding usability and engagement, which can be overcome if research is previously conducted with users, to obtain greater success of these Apps when available to the public.

The articles point out that in all stages of development, effectiveness evaluation, usability and engagement in the use of Apps it is essential to understand the expectations and motivations of the target population and the MH professionals, because in this way it is possible to provide computer technologies that users can absorb in their lives and professionals can indicate them in their practice.

Apps for self-management in MH, when based on evidence, can benefit professionals and users, increase adherence to treatment, reduce failures in the regularity of medications and in the final costs of treatment. The findings reinforce that the stages of construction of these technologies must be conducted as representative samples to legitimize the results.

Development and effectiveness of App for self-management in mental health

With the proposal of App development and efficacy evaluation, 34 studies were found.^{10-13,15-23,25,27,28,30-35,37-39,42,44-48,50,52,54} Focusing on mood monitoring, a total of five were found: one on the effectiveness and another on the development of an App called *MoodPrism*;^{17,22} one on the development of the App *G-MOJI*⁶⁴ based on self-monitoring of mood by means of *emojis*; one focusing on the feasibility of an App to promote positive MH in adolescents, called *CopeSmart*,¹¹ and

another focusing on the development of an App (unnamed) for young people with Major Depression,²⁷ suicidal ideation, and self-harm.

It is noteworthy that, although research on mHealth has been initiated since 2007/2008, the first studies appeared only in 2014 and in little more than a decade there was the introduction of new generation smartphones such as the iPhone and similar devices in the market.⁵⁷ For Bipolar Mood Disorder, two studies were found: one on the development and feasibility of the SIMPLe App¹³ which aims to monitor symptoms/signs and empower self-management of the disorder with personalized psychoeducation content, with user-friendly, non-stigmatizing features and sensitive enough to detect mood changes in order to provide personalized psychoeducational feedback based on a previously tested psychoeducation treatment manual.

From this perspective, the study points out that providing psychoeducational content Apps for ongoing self-management, tailored to specific needs, makes it possible to integrate into the patient's life a comfortable, simple, time-unrestricted, easy-to-use, cost-effective, and noninvasive method of recording and monitoring relevant signs and symptoms⁵⁸ and one on the effectiveness of the *Personal Life-Chart* App (PLC App),¹² based on the National Institute of Mental Health's Life-Chart Method that functions as an electronic diary for patients to validly record and edit the severity of depressive and manic episodes with functional impairment.

What stands out in this App is the potential to graphically provide more evidence about the correlation between self-rated mood and clinical assessments conducted by written rating methods such as scales. Compared to those in previous studies, electronic methods appear to perform better than pen and paper methods, and patients have given preference to electronic diaries.¹⁶

On PTSD, there are 5 studies. One of these refers to the App PTSD *Coach* to refine a non-stigmatizing smartphone intervention for college veterans based on acceptance and commitment therapy;⁴⁸ another that develops a clinical support CS-PTSD Coach²⁰ to use in conjunction with the previous one, followed by one that evaluates the effectiveness of the App with and without clinical support.¹⁸ In this same strand some studies have emerged, the App PTSD *Coach*¹⁰ and the Support

Coach⁵⁰ with the proposal to evaluate the effectiveness of usability and user satisfaction with a self-help tool to reduce trauma-related symptoms. All stand out by proposing to reduce stigmatized views about mental disorders, traditional MH care that considerably reduces access to services, negative cognitions related to trauma and strengthening resilience in coping with adversity.

Related to Eating Disorders, three studies were found: One on the Healthy Body Image Program¹⁶ as an online tool and focusing on individuals with body image problems or eating disorders, one on the TC App based on an mHealth intervention grounded in Cognitive-Behavioral Therapy⁵² and one on the Recovery Record,³⁸ to evaluate the effectiveness of a personalized and fully automated self-help version. All have in common the evaluation of clinical effectiveness, usability, and engagement associated with participant motivation to use a healthy body image program.

There were three about schizophrenia: one about the App *MindFrame* that addresses newly diagnosed young adults²³ and whose use and evaluation have been shown to be an important tool to foster daily management of living with their illness; and two App *WeCope*³⁷ and App *Independence*,³⁵ both aimed at coping with voices, problem solving, goal setting, and stress management. These three App stand out by providing symptom improvement, personal and social functioning, and bringing a sense of recovery.

Two articles have addressed stress: one called PHIT for Duty,²⁸ which integrates relaxation based behavioral education for sleep quality, alcohol use, psychometric, psychophysiological data capture, and the *Pacifica* App³³ which showed self-efficacy on stress self-management. Both have in common the application of mindfulness as effective in reducing self-reported symptoms of depression, anxiety, and stress, particularly among individuals who use thought records and are not taking psychiatric medication.

Also, on depression, the *Kokoro*-app,¹⁹ focused on people with Major Depression resistant to antidepressants, was the first study to demonstrate the effectiveness of CBT with a smartphone in the treatment of depression; one on the App *Be Good To Yourself* that helps control depressive symptoms²⁵ for self-help in dealing with depressive symptoms and detected feasibility and efficacy in

use with reduction of depressive symptoms and improvement of self-esteem; and App *BlueWatch*, aimed at people aged 18 to 25 years³⁰ that showed the engagement of participants through self-monitoring and feedback, as well as personalized messages. These Apps may be a feasible way to maintain participation in self-guided interventions, although the authors suggest further evaluation to determine whether levels of engagement with these resources increase treatment effects.^{19,25,30}

To monitor signs and symptoms of psychosis and relapses, the App ExPRESS⁴² assessed and monitored psychotic symptoms and its acceptability in the long term. It suggests that it is acceptable by individuals diagnosed with schizophrenia across a wide age range, provided the potential benefits are understood; App *EMPOWER*⁶⁹ in a novel study revealed that it is possible to evaluate and record a newly developed digital intervention for psychosis prior to testing in a clinical trial; and App *ibobbly*,¹⁵ in which monitoring for suicidal ideation, depression, psychological distress, and impulsivity among indigenous youth is a feasible and acceptable means.

In the App development and effectiveness category, the authors point out that studies are needed prior to its creation to verify the usability, expectations, and motivations of users and health professionals, to guarantee safe and positive results in the treatment when facing the proposed interventions.

Users' perceptions of the use of App for self-management in mental health

Six studies were found: one on the App Recovery Record,²⁴ a self-monitoring tool for individuals recovering from ED with reminders, affirmations, and patient-doctor linking features that allows both to monitor the data entered.

*Oiva*⁹ on stress management in an academic community showed that most participants found the App useful and would recommend it to others; an unnamed App focused on self-management and control of auditory hallucinations and reveals that this technology helped capture these experiences more accurately and communicate them more effectively to the therapist.⁴⁹

A study on the prevalence of App use for monitoring MH among war veterans⁴¹ indicates that users' perceptions of the App is favorable, and providers recommend its use as an access possibility to

improve patient engagement; and another on Apps for anxiety and depression from the perspective of understanding motivations, experiences, and relationships of the people who used them, showed that it decreases isolation, improves interpersonal support, and reduces reductionist biomedical conceptualizations of MH problems.^{29,53}

The studies conclude that these Apps are used in the daily life of the population and are well accepted, however, the authors point out that one should consider the experiences of users to ensure their real effectiveness, considering that the same intervention can be understood as beneficial to a user and negative for another. These findings add to the emerging literature that shows that these App can play an important role in the treatment of the population.

App for mental health self-management in App stores

Six studies were found^{26,36,14,51,40,43} that aimed to verify the quantity of Apps in online stores and analyze quality and content. Of these, one referred to stress management²⁶ and showed that Apps in online stores are becoming fully integrated self-management systems, such as professional assistance services and online support communities, but interest in these environments is still low.

In one of the studies, which aimed to evaluate the functionality, aesthetics, and information quality of free or low-cost Apps, they claim to target alcohol, benzodiazepine, crack/cocaine, methamphetamine, and heroin use using MARS-validated Apps³⁶ and showed few commercially available with evidence-based interventions and even a worrying number promoting harmful alcohol and illicit drug use.

Another, to evaluate the types of currently available TB symptom monitoring Apps,¹⁴ checked their features and the quality of their content and found that those currently available do not conform to practice guidelines or self-management principles, do not provide important information to help users evaluate their quality, and mostly lack source citation and a privacy policy.

One was about Apps focused on anxiety symptoms⁵¹ and two about MS, in general.^{40,43} The studies conclude that there is many Apps when searching the stores, but when analyzed, most of them are not based on scientific evidence, do not have content related to the search, or even do not

match the principles of self-management established by each study. It is noteworthy that many Apps are focused on the use of gamification features that motivate the user to continue using the tool, but often only a small portion of users use them for long periods. As Apps grow in popularity, scientific production in the area tends to increase, bringing more and more evidence-based Apps, with new features and with greater potential to improve the quality of care.

This review has limitations and, despite efforts to ensure the comprehensiveness of more studies other databases were not used and only articles in three languages (Portuguese, English or Spanish) were selected. The publications excluded from the search did not provide details about the characteristics of the applications and/or did not disclose outcome measures. This study is part of a research project on the development of self-management Apps in MetS for the Brazilian scenario.

The implications of this review for practice are supported by the fact that self-monitoring Apps can be accessed 24 hours/day, in real time, and with the possibility of being tuned to health teams⁵⁹ and, in cases of inability of the user/patient to access health services, when produced based on scientific evidence, be consistent enough to provide an effective clinical response in full time.⁶⁰ For research, this review contributes by presenting the gaps that support the discussion and opportunities for the construction of Apps for self-management in the field of MS. Also, it reveals the lack of national studies on mobile technologies in self-management of treatment in MetS, reinforcing the urgency of investment in this area of research.

Conclusion

This review showed the reality of the literature on the use of Apps in self-management of treatment in MH. It indicated a variety of Apps for various types of mental disorders, self-monitoring of mental disorders and for specific populations, available in online stores. Most studies investigated the development and efficacy of new Apps and showed low quality and interventions without scientific evidence. Few addressed user perceptions in the use of these Apps. There is emphasis on

research on search and analysis of Apps.

The construction of new applications for self-management in MH should, therefore, be based on the gaps found, supported by evidence, with the participation of the public for whom it will be intended, and with representative samples that, in fact, portray the expectations and motivations of the user for the use of these technologies in self-management of their treatment.

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